# CENTRAL LAKE ONTARIO CONSERVATION REPORT

## LAND

ONTARIO DEPARTMENT OF PLANNING AND DEVELOPMENT

CONSERVATION BRANCH

# CENTRAL LAKE ONTARIO

## CONSERVATION REPORT

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## LAND

1960

## AUTHORSHIP

The field work was directed and the report written by A. D. Latornell.

Editing and format were under the supervision of A. H. Richardson, P.Eng., assisted by A.S.L. Barnes, R.P.F.

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## RECOMMENDATIONS

## STATED OR IMPLIED IN THIS REPORT

1. That the Authority publicize the benefits of soil conservation and conservation farming by means of tours, demonstrations and publications.

2. That the Authority continue to sponsor land judging competitions in co-operation with the Department of Agriculture and neighbouring Authorities.

3. That the Authority promote the construction of grass waterways, possibly with financial assistance.

4. That the Authority bring to the attention of municipal officials the serious sources of erosion that exist in new road construction projects, and request that some effort be made to stabilize and grow cover on newly constructed banks and ditches. A demonstration of road bank stabilization might be sponsored by the Authority.

5. That the Authority NOT give financial assistance in the building of farm ponds in view of the assistance already available through the counties. However, the Authority should co-operate with the Department of Agriculture in providing technical advice and assistance.

6. That the Authority investigate the possibility of land use demonstrations, either on Authority-owned property or on private property.

7. That to better achieve its objectives, the Authority enlist the co-operation of local agricultural organizations.

# CHAPTER 1

## GEOGRAPHY OF THE AREA

### 1. Introduction

The area of the Central Lake Ontario Conservation Authority contains 154,880 acres, or 242 square miles. It extends from the easterly boundary of Bowmanville Creek Watershed to the western edge of the Lynde Creek drainage area. It is about 19 miles wide and 12 miles long.

The northern boundary of the area roughly approximates the northerly boundaries of Whitby, East Whitby and Darlington Townships.

The region is bounded on the north-west by Duffin and Carruthers Creeks which are in the Metropolitan Toronto and Region Conservation Authority, and on the east by Wilmot Creek. To the north are several streams flowing into Lake Simcoe or the Trent drainage system.

The nine municipalities in the region are the City of Oshawa (57,683), towns of Whitby (11,943) and Bowmanville (7,203) and the Townships of Whitby, East Whitby (2,564), most of Darlington (8,878) and small portions of Pickering, Reach and Clarke Townships. Hamlets in the townships include Brooklin, Hampton, Myrtle Station, Columbus, Courtice and Enniskillen.

The area is well served by highways and railways. Provincial Highways include the dual-lane 401 and No. 2 east and west through the south part. Numbers 7 and 12 serve the area north and south. In addition there is a good network of county and township roads. The double track Canadian National, and the Canadian Pacific rail lines from Toronto to Montreal pass through the south. Another east-west Canadian Pacific line from Toronto to Peterborough and Ottawa passes across the north.

### 2. Hydrography.

The area of the Central Lake Ontario Authority includes the watersheds, or drainage areas, of a number of small streams. These include Lynde, Pringle, Oshawa, Harmony,

Bowmanville and Soper Creeks. These streams mostly have their sources in the ridge or height of land that forms their north watershed boundary. In addition, there are several small creeks that arise within a mile or so of the lakeshore and flow directly into the lake.

The height of land, often called the Oak Ridges moraine, runs east and west through this part of south central Ontario, dividing south drainage into Lake Ontario from drainage north into Georgian Bay, Lake Simcoe and the Trent River system. This ridge parallels the shore of Lake Ontario at a distance of 15 to 20 miles, limiting south drainage to comparatively small streams. There are few streams on top of the height of land; instead the water soaks down through the porous sand and gravel and gives rise to the streams at the base of the ridge.

(a) Lynde Creek

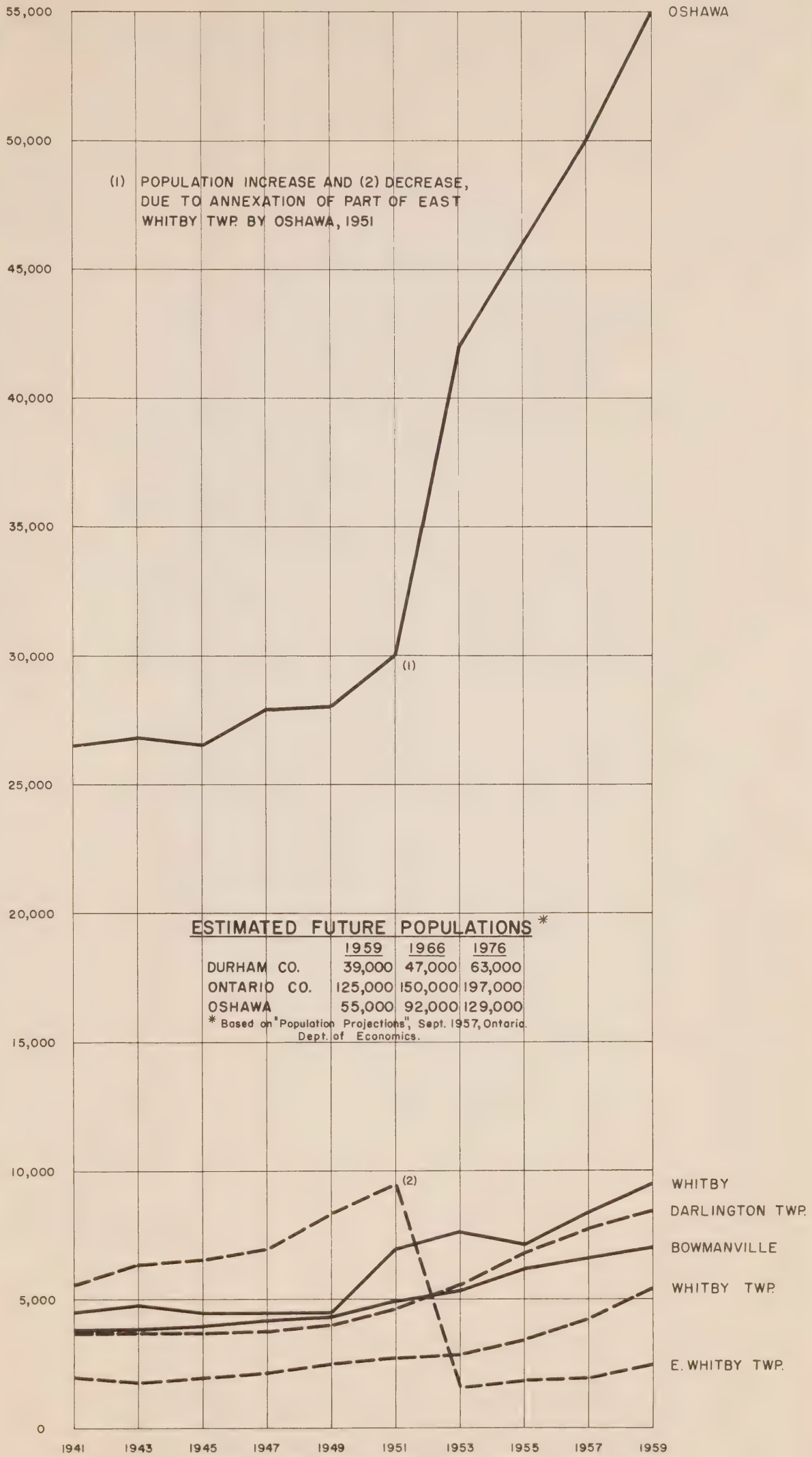
Lynde Creek, the most westerly creek in the Authority area, has its main source in Chalk Lake, the most easterly of the series of "kettle lakes" to be found along the Oak Ridges moraine. The main branch flows through Brooklin and through the western limits of Whitby to empty in the lake through the Ontario Hospital Grounds. A west tributary of this creek has cut a rather spectacular gully nearly 100 feet deep, called the "Devils Glen" west of Brooklin.

(b) Oshawa Creek

Oshawa Creek has its sources at the base of the moraine in the north of East Whitby Township. There are two main branches which join in Concession IV, at the north end of Oshawa. The creek flows through the city of Oshawa to empty into the lake through a marshy area around the harbour.

(c) Bowmanville Creek

Bowmanville Creek is the largest drainage area. Arising in the height of land at elevations of 1,025 feet, it has two main branches which do not join until just before they empty into the lake through a flat marshy area at a harbour known as




## ESTIMATED FUTURE POPULATIONS *

| | 1959 | 1966 | 1976 |
|---|---|---|---|
| DURHAM CO. | 39,000 | 47,000 | 63,000 |
| ONTARIO CO. | 125,000 | 150,000 | 197,000 |
| OSHAWA | 55,000 | 92,000 | 129,000 |

* Based on "Population Projections", Sept. 1957, Ontario Dept. of Economics.

# POPULATION 1941–1959

CENTRAL LAKE ONTARIO

D. P. & D. CONSERVATION BR. APRIL 1960. B.B.

Port Darlington. The east branch is commonly called Soper Creek.

There are several other smaller creeks arising within several miles of the shore, and flowing directly into the lake. These include Pringle and Harmony Creeks.

3. Climate

The main influence in the climate of the watershed area is its proximity to Lake Ontario. Putman and Chapman * in their report on the "Climate of Southern Ontario", described this area as lying within two climatic regions, the Lake Ontario shore, and the south slopes.

(a) Lake Ontario Shore

The direct climatic influence of Lake Ontario is limited to a rather narrow strip several miles wide along the lakeshore. This strip corresponds roughly to the well-marked plain of glacial Lake Iroquois behind which the land rises sharply.

Average annual temperature of this strip is 44 degrees, one degree warmer than the area immediately to the north; Average seasonal temperatures are; winter, 21 degrees, spring 41 degrees, summer 66 degrees, and autumn 48 degrees. The highest recorded temperature is 104 degrees at Toronto, the lowest near 30 degrees; which is equivalent to Kent and Essex Counties.

Average date of the last spring frost is May 8 to 12, the first autumn frost between October 2 and 13, giving a frost-free period of between 141 and 158 days.

Precipitation averages between 30 and 33 inches; moderate snowfall of 60 to 65 inches and rainfall of 15 to 17 inches during the growing season.

(b) The South Slopes

The remainder of the area falls within the "South Slopes", i.e. all the land sloping south from the north boundaries

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* Putman, D.F. and Chapman L.J. The Climate of Southern Ontario, Scientific Agriculture, 18:8, April 1938.

of the watershed to within several miles of the lakeshore. This area does not enjoy the direct modifying influence of the lake; nevertheless the climate is somewhat milder than regions to the north.

Most of this area is between 500 and 1,200 feet in altitude. The yearly average temperatures range from 43 to 45 degrees, with spring averages between 41 degrees and 42 degrees, summer 66 degrees and autumn at 47 degrees. The frost-free season is 133 to 147 days.

Annual precipitation varies from 32 to 38 inches with a little less than half during the April to September period; snowfall varies from 50 to 90 inches.

4. Physiography*

The maximum elevation in the Central Lake Ontario area is about 1,200 feet in the north-west, near Chalk Lake. Average elevation along the north boundary is 1,100 feet and along the Lake Ontario shore 275 feet. This is a drop of over 800 feet in 12 miles.

To better understand the distribution of various soils and the problems associated with their use, and their capability to produce crops, a knowledge of the physiography or surface relief is desirable.

The land features of most of the north portion of this continent are due to the actions of great continental glaciers. These tremendous agents of erosion and deposition helped shape the landscape of Ontario.

In the past one million years, which, geologically speaking, is a relatively short space of time, most of Canada has been covered at least four times by huge sheets of ice. It has been estimated that these continental glaciers have been two miles thick in some places. These glaciers emanated from two main centres in Canada's north, - the Keewatin district, and the

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* Information in this section based on "The Physiography of Southern Ontario, Chapman, L.J. and Putman D.F. University of Toronto Press, 1951.


PHYSIOGRAPHY
LEGEND
DRUMLINS
TILL PLAIN
SAND PLAIN
CLAY PLAIN
KAME MORAINE
BEACH AND SHORECLIFF
BEACH
PICKERING
WHITBY
DARLINGTON
CLARKE
ONTARIO
LAKE
Chalk Lake
Lynde Creek
Oshawa Creek
Goodman Creek
Osbourne Creek
Farewell Creek
Black Creek
Soper Creek
Mackie Creek
Bowmanville Creek
1/2 0 1
D.P.B.D. CONSERVATION BR. 1959 C.S.V. CENTRAL LAKE ONTARIO

highlands of Labrador and Quebec. Climatic changes caused these ponderous ice flows to move across the land and recede again. Between the several ice ages there were long periods when the climate was warm, probably warmer than now, and the land was ice free.

The ice of the last major glacial period, usually called the Wisconsin Glacier, because its results were first identified in that state, covered all of Ontario, and extended south to the Ohio and Missouri rivers in the United States. This occurred some ten to fifteen thousand years ago. It was responsible for our present landscape. Its movement, as it spread out from arctic regions, may perhaps be compared to the enlarging of a pancake as batter is poured into a pan. As the great continental ice sheet moved forward, it acted as a plough, pushing, scraping and grinding the underlying bedrock and surface deposits and spreading them about. The resultant pulverized material is a conglomerated, heterogenous mixture called "till".

Till is composed of clay, sand and stones. The rock materials forming it are often carried considerable distances from the point of origin. The moving ice also gouged out great rock fragments which scraped at the rock floor over which they were carried. Sharp corners and edges of even the hardest rocks were ground smooth by this abrasive action to form the rounded rocks and stones common to glaciated landscapes, and so frequent in many parts of Ontario.

Between its advances, warmer weather caused recessions in the glacier, when part of it melted. One can only imagine the fantastic amounts of water released. These meltwaters, rushing away from the melting face of the glacier, carried with them large amounts of loose rock. This rock was later deposited as the water decreased in velocity and volume. Rock and other soil-building material deposited in such a manner is called glacio-fluvial ("glacio" referring to the rocks being pushed up by the glacier, and "fluvial" that the material was

moved about by water").

Succeeding continental ice sheets, or minor advances and recessions of the same one, molded Southern Ontario as we see it today. The last, or Wisconsin glacier, was most responsible. Landforms resulting from this ice action are of several kinds, a number of which may be found in the area of this Authority.

(a) Till Plain

During its movement, the ice often spread the mixed till material about underneath it to form a rolling plain, or "till" plain. Such a till plain extends across the northern part of the watershed, extending north from Brooklin and Hampton through four or five Concessions. Streams flow directly down its slopes; they are rapid and usually have deeply cut valleys. Erosion along the slopes down to the streams is often a problem. A feature often characteristic of till plains is the elongated hills known as "drumlins". In shape they are like the inverted bowl of a spoon and they are often called " whale-backs". Drumlins are formed on till plains where there is an abundance of clay. It is believed that as the glacier advanced, it over-rode some impediment, and material being carried on the lower part of the glacier became plastered against this impediment, slowly building up an oval-shaped mound. The accompanying map of the physiography of these watersheds shows the location of the drumlins, and indicates the directior of glacial movement.

Drumlins vary in size. They are usually up to 75 feet high, a mile long and a third of a mile or so wide. They occur in groups or "fields", with their long axes pointing in the same direction. There are numerous drumlins in these watersheds. Mostly they point in a north-south direction. There are a number in the district around Taunton and Hampton, in the east end of Concession IV, East Whitby Township, and the west end of Concession V of Darlington. There are also some arcund Oshawa and Whitby.

Drumlins, although usually composed of soil of

good texture and fertility, do present limitations in their use. The sides are often steep, and characteristic up-and down-hill cultivation makes erosion a hazard. Attempts at contour cultivation and strip-cropping are often hampered by the traditionally square or rectangular fields.

Between drumlins, land is often low, depressional and poorly drained. Such land must be artifically drained before it is good crop land.

(b) Moraines

Through its various movements, the glacier often piled up quantities of till material along its edge to form ridges. These ridges are called "moraines". They are often covered with sand or gravel and may run for miles.

During the Wisconsin glaciation, two separate lobes of ice lay over south central Ontario. One lay in the basin now occupied by Lake Ontario, the other to the north over Lake Simcoe. Between these two lobes, glacial melt-waters deposited one of the most prominent moraines in Ontario, the Oak Ridges Moraine. Extending from near Orangeville, eastward to Rice Lake, it forms the height of land dividing drainage into Lake Ontario from drainage north into Georgian Bay, Lake Simcoe and the Trent River.

The Oak Ridges Moraine forms the north boundary of the watersheds of this Authority. The soils of the moraine are mostly sandy or gravelly, and high in limestone. The topography and the susceptibility of the soils to wind and water erosion limits their value for agriculture.

(c) Clay Plain

The area now occupied by Lake Ontario, as well as land along its border, was once covered by a body of water known as Lake Iroquois. Beaches and cliffs of its old shoreline are easily identified features today. The portion of the lake bottom is now exposed as clay plain extending from the Niagara River around the end of the lake, and through Toronto and Oshawa.

to the Trent River. In width it varies from a few hundred yards to several miles.

Within the Authority, this clay plain varies in width. At one point it extends north to the 6th Concession of Pickering Township, narrowing to the 3rd Concession of Darlington north of Bowmanville. Some of the soils are heavy clay, and poorly drained. There are numerous drumlins.

Dividing this clay plain from the till plain to the north are the shoreline remains of ancient Lake Iroquois. They are easy to trace, exhibiting bouldery, stony or sandy material common to any present day shoreline. It crosses and recrosses Highway No. 7 at several points west of Brooklin and then goes south-easterly into Concession IV of Darlington and through the village of Tyrone. Along, and below this beach line lies a narrow sand plain. Much of this sand plain is unsuited to farming, being poorly drained and producing only scrub forest growth.

Summarizing, the region drained by the streams of this Authority can be divided into four main areas, according to the physiography. They are the Oak Ridges moraine, the rolling till plain, the Lake Iroquois shoreline with its attached narrow sand plain, and the clay plain.

While the broad patterns of the watershed were formed during glacial times, some landscape development has taken place since the ice retreated. This includes the development of the river valleys and rounding off and shaping of landforms by erosion.

# CHAPTER 2
## SOILS OF THE WATERSHED

### 1. Factors in Their Formation

Soil can be described as the medium in which plants grow. It is the link between the earth's rocky core and life upon its surface. Soil is continuous over the land surface except for mountain and polar regions.

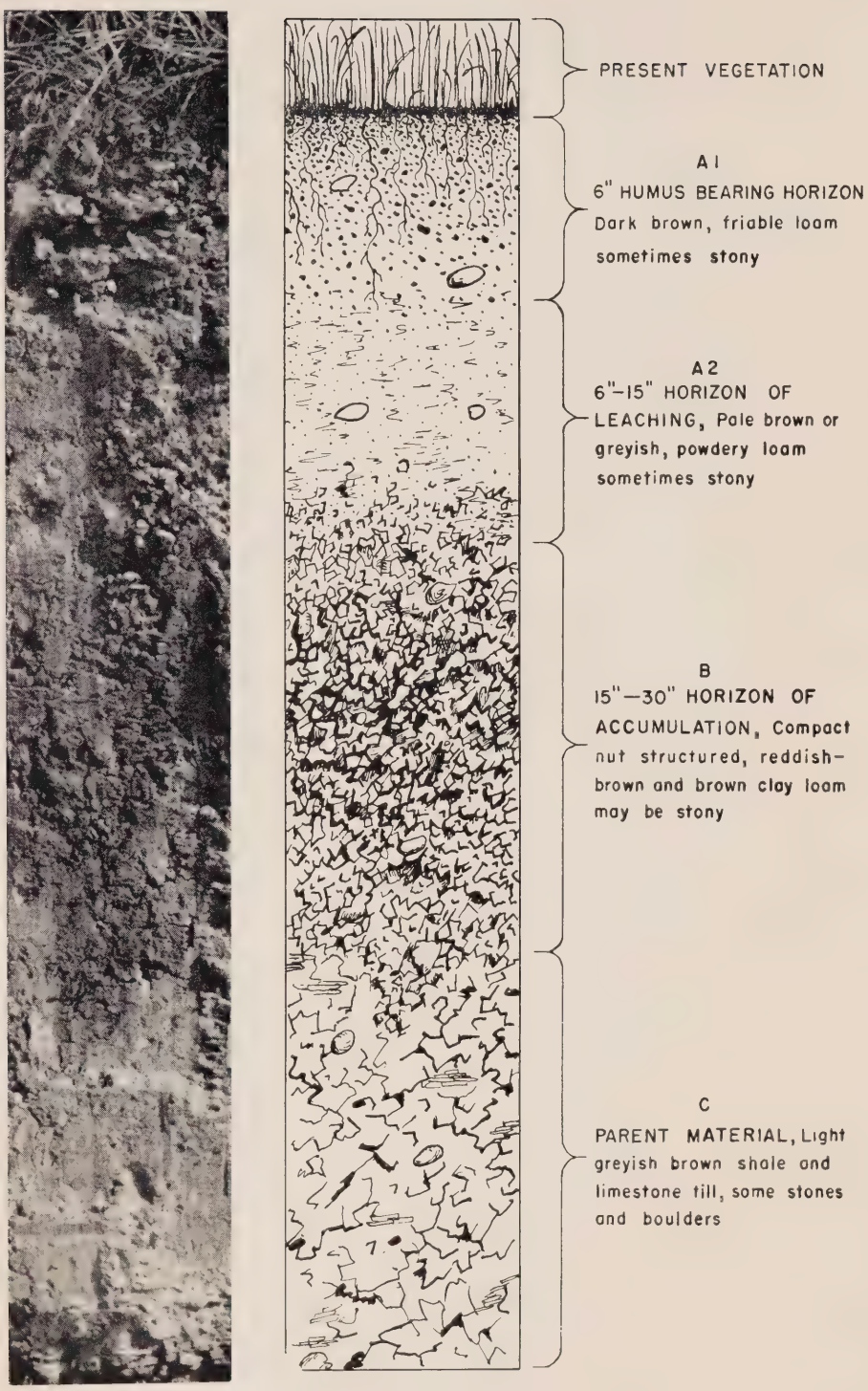
Most soils are developed largely from broken rock materials. In Ontario, at least, this breakdown was started by glacial action, and completed by various weathering processes. The rock material may become mixed with living or dead organic matter. This whole process of soil formation may take thousands of years.

The parent rock material, together with organic matter, air and water, are the "building blocks" of soil. The proportion of each component, i.e., the "number of blocks" varies from soil to soil, and therein lie their differences. These differences are not only in the physical qualities of the soil itself, but in the ability of a soil to support growth.

Almost every soil is made up of several layers or "horizons". Together, these horizons are called the soil profile. A profile can be described as a vertical cross-section cut to the unweathered and unaltered material from which the soil was formed. Examination of the profile is basic to any scientific study of the soil; the profile tells a story of the development of that particular soil over the centuries.

A soil's profile is the end result of combined influences exerted over the centuries in the formation of that soil. These influences include the type of bedrock, climate, slope, age of a soil, vegetation and drainage. These several influences operate in varying degrees to eventually produce the different kinds of soils. Each kind of soil has certain recognizable characteristics. These can be observed from an examination of the soil profile.

Soil horizons differ in one or more properties




*Profile of a representative gray-brown podzolic soil.*

such as colour, texture, depth, consistency and structure. They may be thick or thin. For purposes of description most soil profiles have three main horizons, identified by the letters A, B, C.

The "A" horizon or upper layer is often called the top or surface soil. It is the part of the soil in which life is most plentiful, and where most of the organic matter is found.

The "B" horizon lies immediately below the "A" layer. This layer is often called the subsoil. The third or "C" layer is the deepest, and usually lies next to the rock material from which the soils above are formed. The "C" horizon is therefore often called the parent material layer.

The soil parent material comes from the break-down of rocks by glacial action and weathering. Sunshine, rain, frost and wind, heating and cooling weaken and break down rock into very small pieces. This, of course, requires tremendous time. Dead and decayed plant and animal growth, in the form of organic matter, becomes mixed with the upper layers.

Differences among soils are many. They can vary within a farm or a field on the farm or the differences can be distinguished in a much wider basis, such as a county or a region. These differences are the basis of the classifications and descriptions of soils.

## 2. Soil Surveys and Maps

Soils can be classified and named, just as can plants and animals. Such characteristics as leaf and flower are used to identify plants. The number and kind of layers or horizons, their colour and depth, are the characteristis used to identify, describe, name and map soils.

A knowledge of the soil is basic to any soil management and soil conservation program. Every farmer knows, of course, whether his soil is clay or sand, poorly or well drained.

But a more scientific designation and description is often necessary. This information is obtained by means of a soil survey. These surveys are usually carried out on a county basis.

A soil survey includes examination of each kind of soil, finding out which of its properties are important, classifying the soils into various units, mapping the boundaries of these units and making full descriptions of each kind of soil.

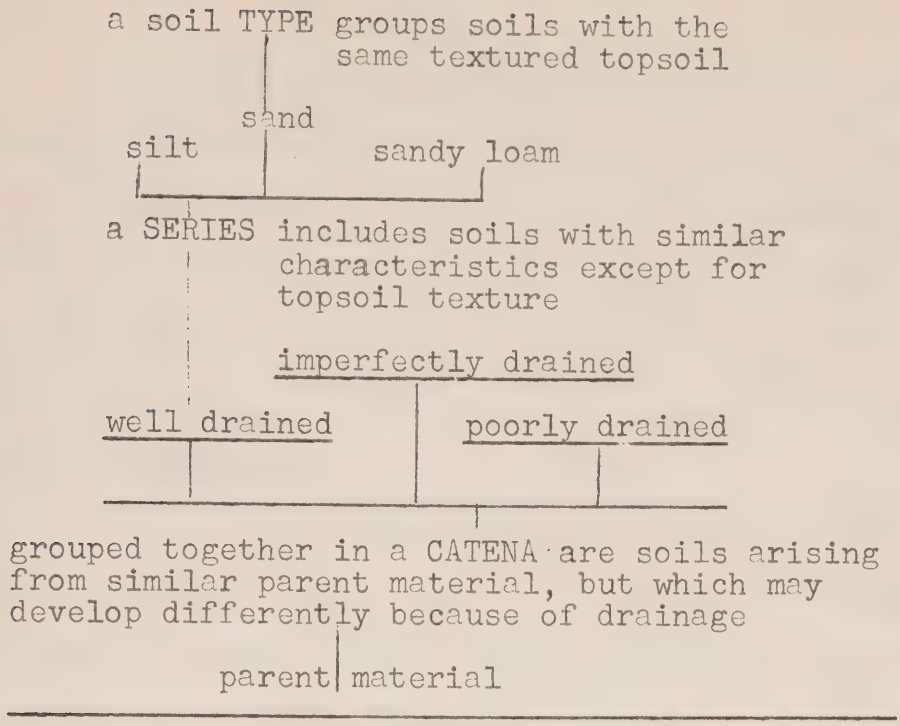
Soil surveys in Ontario are carried out co-operatively between the Soils Research Institute, Research Branch (formerly Experimental Farms Service) Canada Department of Agriculture, and the Ontario Agricultural College.

The soils of any area may be grouped according to the kind and origin of their parent material. These parent materials are derived from the bedrock, and may have been worked over and moved about by glacial action.

Where a group of soils has developed from the same kind of parent material and possesses similar horizons or layers, it is called a soil "series". Within a series, the main difference may be in the texture of the surface soil layer. Soil differentiation based on topsoil characteristics is called a soil "type".

Where soils have developed from the same parent material, but have different horizons, (and hence different profiles) due to differences in drainage or topography, classification may be on the basis of a "catena".

Thus there may be well-drained, imperfectly-drained, and poorly-drained soils developed from the same parent material.




In mapping and describing soils, a number of descriptive terms are used:

"texture" refers to the size of soil particles, i.e. clay, silt, etc.

"consistency" as when a soil is sticky, as a wet clay, or open and crumbly, as a sandy loam.

"structure" is the arrangement of the individual soil particles into larger units, i.e. single structure as in sand, crumb structure as in soil well supplied with humus, or cloddy as in heavy clay.

3. Soils of the Central Lake Ontario Region*

As already described in the sections of Chapter I dealing with the physiography of the area, the landforms of Ontario were shaped largely by glaciers. The area included in this Authority is divided into four physiographic regions: the Oak Ridge Moraine, the rolling till plain, the sand plain with its ridges of the old Lake Iroquois shoreline, and the clay plain, the ancient Lake Iroquois lakebed. The soils of the region were developed within these regions from conditions imposed by actions of the ice.

* Material in section (3) taken from Soil Survey of Durham County, Soil Survey of Ontario County.

The classification of soils is, in fact, based on the method of deposition of the parent material from which they were formed. Soils exhibiting the same characteristics and which are from the same parent material are given names, usually associated with the location where they were first mapped in Ontario.

(a) Till Deposits

Till is that part of the parent material deposited by and underneath the ice. It is generally an unconsolidated heterogeneous mixture of clay, silt, sand, gravel and boulders. Because of this mixture, till can give rise to a variety of soils. Over a large portion of the southern half of the watersheds, the till is derived from limestone bedrock.

A number of the soils in the area are derived from till. Bondhead is the most commonly occurring soil in the region. This soil is an open and well drained loam or sandy loam. Most of the Bondhead soils are mapped in the upper portions of the watersheds. In the Bowmanville Creek Watershed it is the predominating soil in the upper half, i.e. on the rolling till plain. Bondhead soil occurs on a topography that varies from level to steep; most of it is gently rolling.

Dairy farming is the main enterprise on Bondhead soil, hence grain, hay and pasture are the chief crops. Some canning crops are grown. Because of the light open nature of Bondhead soils, erosion can be serious on the more rolling areas, and definite control measures must be used.

Associated with Bondhead soils are the Guerin and Lyons series. Guerin is imperfectly drained, and Lyons poorly drained. Guerin soils need improved drainage to grow a wide range of crops. Lyons soils are poorly drained and best used for pasture. Erosion is not usually serious.

Darlington soil also originated from till, and occurs widely. This soil varies from loam to silt loam. Drainage is usually good. It occurs in large areas around

Columbus, Raglan and Myrtle Station in the Oshawa Creek Watershed. It is also found around Bowmanville and north of Hampton.

Gully and sheet erosion can be serious, and particularly when intertilled crops are grown on them, care should be taken to prevent erosion.

(b) Outwash Sands and Gravel

The melting of the glacier carried with it quantities of material which was laid down as deposits of sand, silt or clay, depending on the velocity of the meltwaters.

Soils of the Brighton group are derived from such outwash material. Areas of this soil are to be found immediately north of Oshawa, and in the east end of Concessions III and IV of Darlington Township.

Surface texture of Brighton soil is usually sandy loam. Drainage is good; some of these soils may be quite stony. Topography is mostly level to gently sloping. There are a few hilly or steep spots near the stream courses.

Brighton soils, because of their coarse texture, are low in fertility and organic matter. They are used extensively for market gardens, orchards and to some extent, tobacco.

The Dundonald series also comes from glacial outwash. Most of it is found in the north end of the watersheds along the moraine of the height of land.

Dundonald soils are well drained, with mostly gently rolling topography. Wind erosion can be a hazard if the soil is left bare. Dairying is the main farming activity.

The Pontypool soil series is found mostly along the height of land forming the north boundary of the Authority. This series is usually sand or gravel, mostly well drained and usually rolling or hilly. The light soils are susceptible to both wind and water erosion; this, along with steep topography, limits them for agriculture.

Large areas, particularly in the Bowmanville

Creek Watershed, have been reforested, or are growing Christmas trees. Most of the remainder is pasture.

(c) Soils Developed from Lacustrine (water laid) Material

Glacial Lake Iroquois once covered the southern parts of the watersheds. Where this occurred; there are many deposits of clay, laid down by these ancient lake waters (hence the word lacustrine). The main characteristics of these types of soils are heavy texture and freedom from stones.

Newcastle is the main series of lacustrine origin. It was mapped in the Bowmanville Creek Watershed around Bowmanville, within the area once covered by Lake Iroquois. The topography is gently rolling; the soil is loam or clay loam. Drainage is usually good, with some areas imperfect, and most crops will do well on the soil. Most of the orchards in the district are found on this soil, as well as canning crops and nurseries.

(d) Soils developed on Flood Plains along Stream Courses

Soils along stream courses, subject to periodic flooding are classified as Bottom Lands. The actual soil itself may vary. In most cases it is best suited to permanent pasture or forest.

(e) Soils developed from Organic Sources

Organic soils may be found along stream courses, and low-lying areas of very poor drainage. Organic soils may be peat or muck. The former is only partly decomposed, whereas the latter is well broken down.

Organic soils are usually covered with swamp growth. They provide wildlife habitat and may be a water supply reservoir.

4. Land Use Capability

Soils inventories and soils maps are basic tools in developing any system of land management based on soil and water conservation. Soil conservation should imply soil

Hay on Class II land with Class III in background on farm north of Bowmanville.

Good pasture is essential for the many dairy herds in the area.

One of the numerous apple orchards in the Bowmanville area. This one is on Newcastle clay loam.

maintenance and improvement; this is the ultimate goal of soil management.

A system of land classification has been developed by the Soils Department of the Ontario Agricultural College, and others interested in land classification. This system is based on one developed by the Soil Conservation Service of the United States Department of Agriculture, and helps to organize all the soil facts of significance for conservation use. It is known as a "Land use Capability Classification". The term "Capability" relates to the hazards and limitations inherent in a piece of land.

A land capability classification is based on the soil map, and such other information as topography, slope, drainage, freedom from stones, and susceptibility to erosion.

To classify land according to its capability, eight classes are used, numbered from I to VIII. Soils that can be used in the same way and will give about the same crop yield are grouped into one class.

Classes I to IV are suited to cultivated crops; V to VIII are not generally suited to cultivation and are used for pasture, woodland or wildlife purposes.

Capability Classes

A. Land Suited for Cultivation

Class I — Consists of soils with no, or very slight, use limitations. Soils are level, deep, well drained, and easily worked. They are not subject to erosion or flooding. Soils in this class are suitable to intensive cultivation without special measures.

Class II — Consists of soils subject to moderate use limitations. They are good soils that can be cultivated with a few easily applied practices.

Soils of this class may have up to a 6 per cent slope, be moderately susceptible to erosion, or need drainage. They are generally stonefree, but may be subject to occasional flooding

They are suitable to permanent cultivation with such practices as soil conserving rotation, grass waterways or tile drainage.

Class IV and VI land in the upper end of the Oshawa Creek Watershed.

Class IV, V and VI land is common in the north end of the watersheds. Most of it is best used for grazing or forestry.

Crop rotation of corn (foreground) hay and oats on Class II land.

Class III — Are soils subject to many cultural limitations. They may be subject to severe risks or damage; nevertheless they are moderately good soils which can be used regularly for crops with proper treatment.

Soils in this class may be quite subject to erosion, have slopes up to 12 per cent, need drainage, be quite stony or shallow. These limitations often restrict the choice of crops and tillage operations.

Class III soils require cropping systems that provide adequate soil cover. Measures needed are long rotations, including sodcrops, contouring and strip-cropping, grass waterways or artificial drainage.

Class IV — Is composed of soils with severe permanent cultural limitations or hazards. They may be cultivated occasionally with great care. For the most part they should be used for permanent grass cover.

These soils are subject to such limitations as severe erosion susceptibility, shallow or infertile soils, poor drainage which cannot be corrected easily, steep slopes, or they may be stony and bouldery.

B. Land not suited to Cultivation

The soils in the last four classes are not suited to cultivation, but should be kept in permanent cover.

Class V — Soils have few limitations or hazards. Cultivation is not possible because of wetness or stoniness.

This class includes muck lands, bottomlands and level stony soils. Under permanent vegetation, pasture or forest, it may be used without restriction.

Class VI — Soils are subject to moderate permanent hazards for grazing and forestry. They may be subject to erosion, be stony, shallow or steep.

Woodlots should be fenced. Pasture should be adjusted to carrying capacity or season.

Class VII — Soils are severely restricted for forestry or pasture. They may be very steep, severely eroded, swampy, arid, blowsand, or very shallow outcrop of rock.

Class VII lands are subject to many limitations for grazing or forestry. Most should be in permanent forest cover. Some may have value for recreation or wildlife.

Class VIII — Soils are too rough, even for grazing and forestry. Such soils as extremely rough barren land or undrainable marshes are in this class. This class is best suited to wildlife or recreation.

5. Land Conditions in Bowmanville Watershed

Graphs accompanying this section, and the section on Oshawa Creek following, were compiled from data gathered by the surveys of the watersheds.

From the graphs it may be seen that while erosion is not a problem in over sixty per cent of the Bowmanville Watershed, one third does suffer from moderate erosion. This means that from one half to all of the topsoil has gone. This has occurred, of course, on the sloping land; often where the slopes are quite moderate, and the fields used regularly for crops. Mostly, sheet erosion has washed the soil away. On about three per cent of the land, severe erosion has taken place. This is mostly in the upper part of the valley, where slopes are steep and the soil light. Much of the most severely eroded land has been over-grazed; it should be planted with trees, either by the landowners or by an Authority program.

About two-thirds of the watershed is level, or only gently sloping. On this land, soil problems are mainly of drainage or fertility maintenance.

Both erosion and topography, as well as drainage, are used as a basis for land capability classification. In this watershed, some 88 per cent of the area is workable land. Over 78 per cent is either Class I or II. This means that it can be safely and productively cultivated with no, or only slight, restriction for any crop.

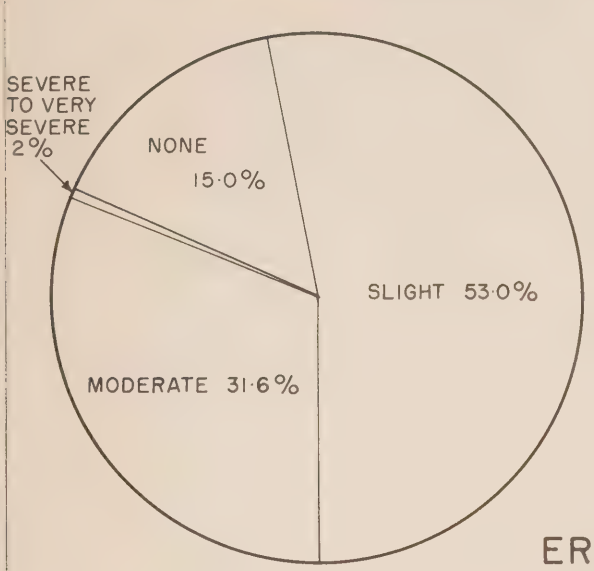
Class III land includes 18 per cent of the watershed area where considerable care is necessary in cultivation to avoid or control a tendency to erosion, mainly on long slopes.

About 12 per cent of the watershed is unsuited to cultivation. Over half of this is Class V bottomland, which is too wet for cultivation, but may be good pasture land. Class VI and VII land mainly consists of steep sides of valleys and an area of rough land in the upper part of the watershed

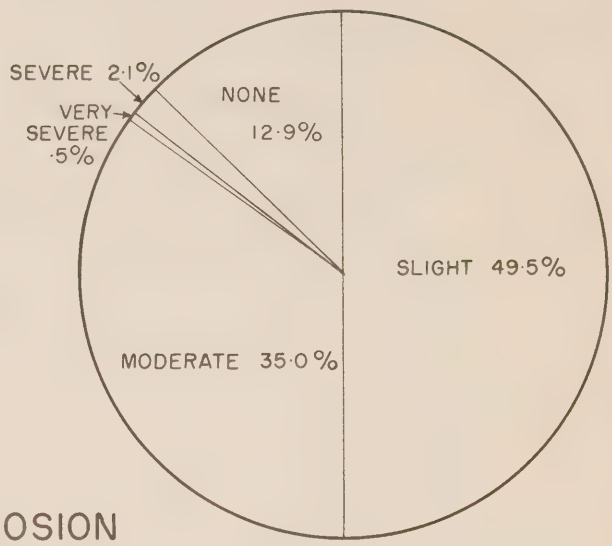
# PRESENT LAND USE CONDITIONS

IN REPRESENTATIVE WATERSHEDS

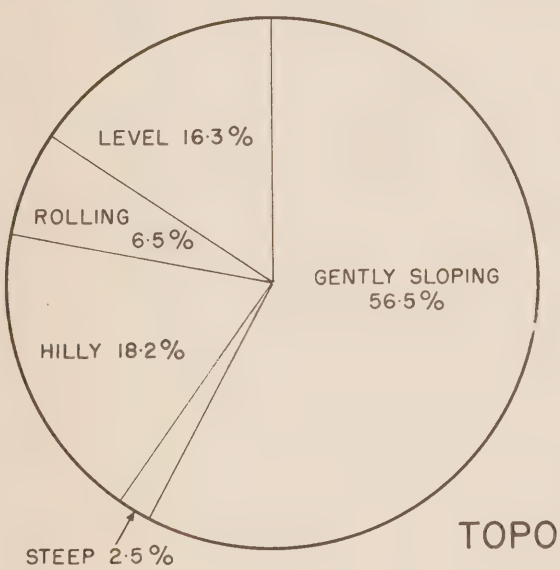
## OSHAWA CREEK

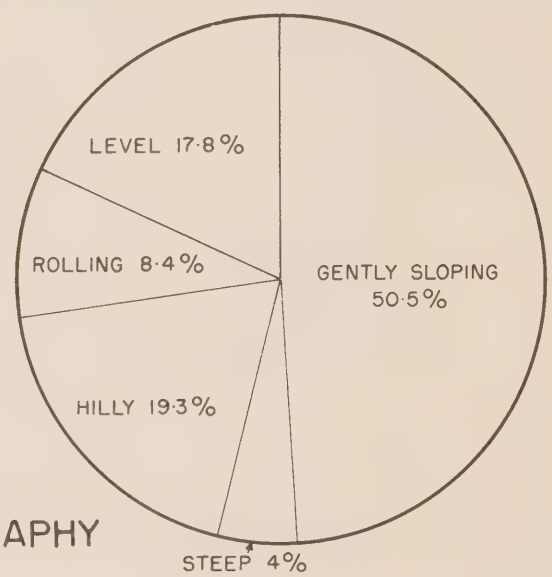



## BOWMANVILLE CREEK

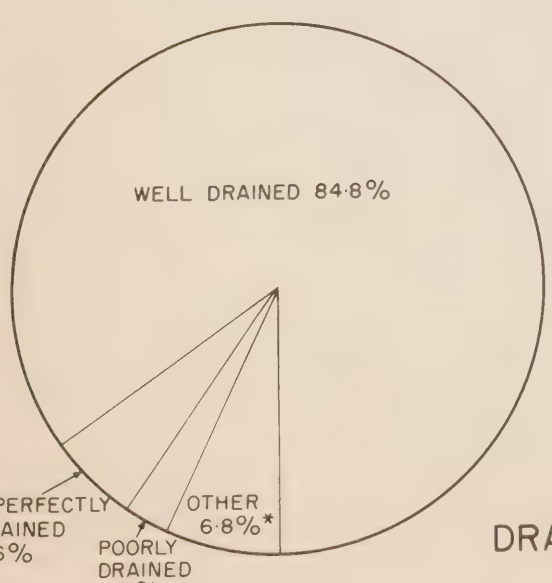


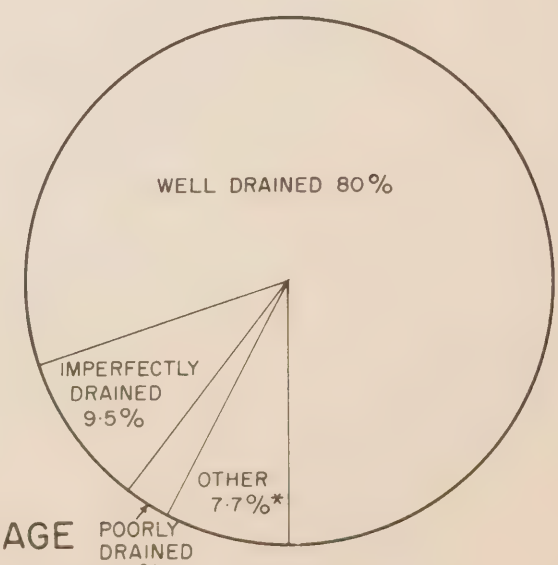

## EROSION




## TOPOGRAPHY




## DRAINAGE

*MARSH & URBAN AREAS

CENTRAL LAKE ONTARIO

D.P. & D. CONSERVATION BR. E.E.M. 1960

along the moraine.

6. Land Conditions in the Oshawa Creek

Soils of the Darlington and Bondhead series are the most common in this watershed. They are well drained productive loams. More than 90 per cent of the watershed land can be described as well drained; 73 per cent is either level or gently sloping, and on 68 per cent erosion is not a problem. This gives a picture of a watershed with easily managed, productive soils.

However, there are problem areas. Nearly one-third of the soils are subject to moderate erosion. In several areas, mostly in the north, erosion is serious. It is found often along hills leading down to stream courses. There are several bad gullies in Concessions VIII and IX of Whitby Township.

In classifying the watershed according to its land capability, we find that 83 per cent is workable. Over half of the watershed falls within Class II category, which means that it is very good land for most farming purposes. The 7 per cent of Class I land is mostly in the lower part of the watershed.

Class V land is either bottomland on stream courses, or poorly-drained, wooded areas described as muck.

7. The Conservation Survey

During the summer of 1959, a Conservation Survey of the resources of the watersheds of the Authority was carried out by this Department. The survey included land and soil resources.

The land use survey was based on the county soil reports and maps. Time limitations confined a detailed survey to the watersheds of the Bowmanville and Oshawa Creeks. However, these typify land conditions in the other watersheds in the Authority.

# LAND CAPABILITY CLASSIFICATION

| MAJOR LAND USE GROUPING | LAND CAPABILITY CLASSIFICATION | | AREA OF EACH CLASS IN WATERSHED | | | |
|---|---|---|---|---|---|---|
| | | | OSHAWA CREEK | | BOWMANVILLE CREEK | |
| | | | ACRES | % | ACRES | % |
| SUITED FOR CULTIVATION | I | FEW LIMITATIONS. MAY BE USED FOR INTENSIVE CULTIVATION WITHOUT SPECIAL CONSERVATION MEASURES. EXCELLENT LAND. | 1,662 | 7·3 | 6,220 | 17·2 |
| | II | MODERATE LIMITATIONS. MAY BE USED FOR CULTIVATION WITH A FEW CONSERVATION MEASURES. VERY GOOD LAND. | 11,834 | 51·5 | 18,328 | 50·9 |
| | III | SERIOUS LIMITATIONS. NEEDS REGULAR ATTENTION TO CONSERVATION MEASURES. GOOD LAND. | 3,892 | 17·0 | 6,490 | 18·0 |
| | IV | SEVERE LIMITATIONS. USE ONLY FOR OCCASIONAL CULTIVATION WITH MANY RESTRICTIONS. MODERATELY GOOD. | 1,954 | 8·8 | 972 | 2·7 |
| NOT SUITED FOR CULTIVATION | V | UNSUITED TO CULTIVATION BECAUSE OF WETNESS, FLOODING OR STONINESS. FEW LIMITATIONS FOR FORESTRY OR GRAZING. | 1,454 | 6·4 | 2,194 | 6·1 |
| | VI | MODERATE LIMITATIONS FOR GRAZING OR FORESTRY DUE TO STONINESS, DROUGHT OR STEEP SLOPES. | 1,910 | 8·5 | 1,364 | 3·6 |
| USE FOR PERMANENT VEGETATION | VII | SEVERE LIMITATIONS FOR GRAZING OR FORESTRY DUE TO VERY STEEP, WET OR ROCKY LAND. | 66 | ·5 | 570 | 1·5 |
| | VIII | SUITED ONLY FOR RECREATION OR WILDLIFE EXTREMELY ROUGH, ARID OR SWAMPY LAND. | | | | |

Within the Bowmanville and Oshawa Watersheds, the land was traversed by field parties. Land resource information was mapped on aerial mosaic photographs. Primarily, information on drainage, erosion, farm ponds, gullies and other significant data were recorded. Where desirable, more detailed soils information was also mapped.

This report is based on information from the survey. This is particularly true of the land capability classifications. Much detailed information is included in the field photographs. It has not been possible to compile all of it for this report. This additional information is available to Authority staff and officers, and to municipal officials, and the staff of other departments, to assist them in more detailed planning of projects.

Sample Block

To enable the reader to better understand the method of carrying out the survey, and to show the type of information available from the field survey photos, an aerial photograph of a sample block is reproduced in this section. The area is in the Bowmanville Creek Watershed, Township of Darlington, Concession V, Lots 3 to 6.

The block is typical of land in this part of the watershed and is representative of the variations in the soil types, drainage and slopes to be found in similar-sized areas throughout all the watersheds of the Authority.

To assess land capability, the present condition of the land must be known. Accordingly, the field survey noted soil types, erosion, drainage and slope conditions. Each area of differing slope, drainage or other condition was outlined on the photograph and identified by symbols. The dividing lines between the different soils, slopes, etc., give the photographs their characteristic "jigsaw puzzle" look.

Any other significant features found in the field were also mapped - farm ponds, unusual crops for the district, gravel pits, gullies, blowsand, etc.

# —SAMPLE BLOCK—

## CENTRAL LAKE ONTARIO CONSERVATION AUTHORITY

## BOWMANVILLE CREEK

DARLINGTON TWP. – CONCESSION V
LOTS 3-6

—LEGEND—

EXAMPLE – BI(SOIL) A(SLOPE) 2(EROSION)

BI – BONDHEAD LOAM
ROLLING TO HILLY. FEW STONES

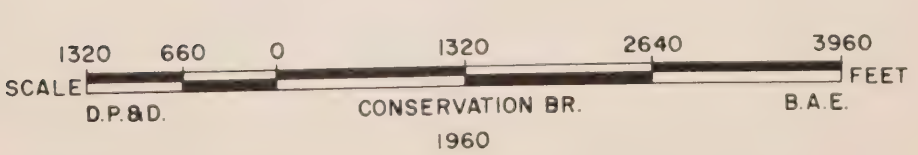
Bg – BRIGHTON GRAVELLY SAND
COARSE SAND MIXED WITH GRAVEL & COBBLES

Dal – DARLINGTONLOAM
HEAVY LOAM WITH FEW STONES

B.L. – BOTTOM LAND

A – 0-2 %
B – 2-6 %
C – 6-10 %
D – 10-15 %
F – 20-30 %
M – 0-7 %
N – 7-15 %
P – 15-25 %
R – 25+ %
} HUMMOCKY

0 – NO EROSION
1 – SLIGHT EROSION
2 – UP TO 2/3 TOPSOIL GONE
3 – TOPSOIL & UP TO 1/3 SUBSOIL GONE
4 – ALL TOPSOIL & UP TO 2/3 SUBSOIL GONE

Given all this information on land conditions, a soils technician, or the landowner himself, can quite readily assess the capability of the soils of an area, and suggest or make desirable changes. Information from land surveys can also be of use in carrying out stream improvement projects, water control schemes and other conservation projects.

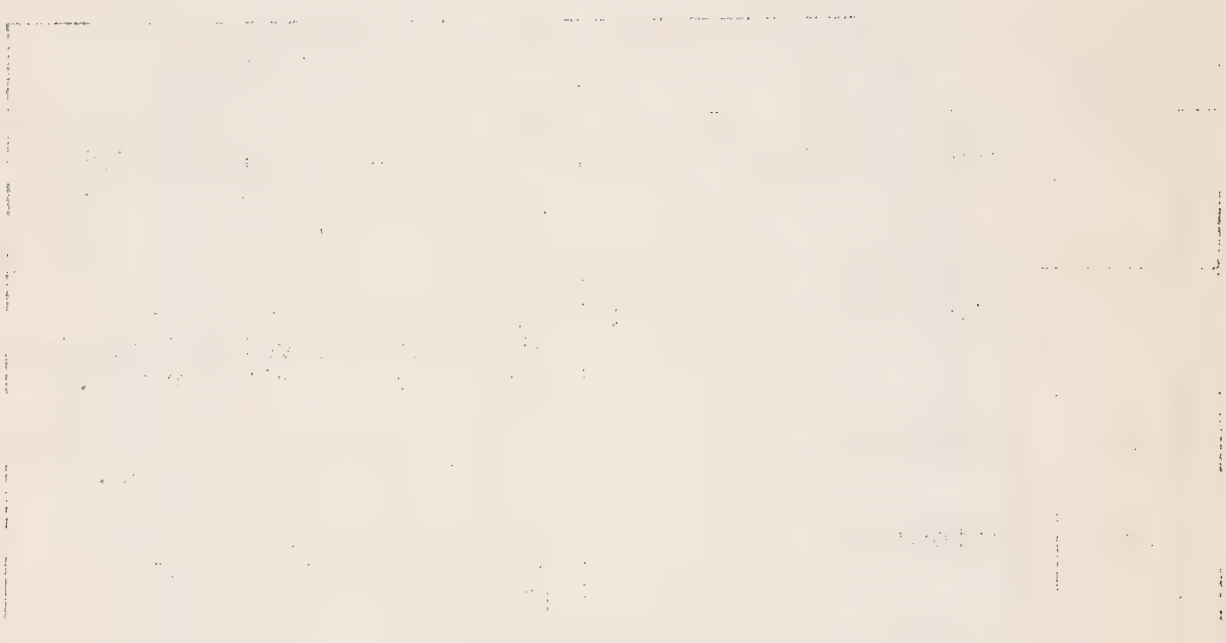
Explanation of symbols used in identifying soils, drainage, erosion, etc., is given in the following tables:

| Soils Symbol | Soil | Description |
|---|---|---|
| Bl | Bondhead Loam | Deep gray-brown loam, high in lime, few stones, rolling to hilly. |
| Bg | Brighton gravelly sand | Light brown coarse sand mixed with gravel and cobbles and underlain with gravel. |
| Dal | Darlington loam | Dark gray-brown heavy loam, high in lime, few stones. |
| B.L. | Bottomland | Land lying along stream courses and subject to flooding |

This block slopes from the highest point in the north-west corner to the south and to the east. The farm in Lot 6 is operated under a farm plan drawn up by the Soil Advisory Service. The long slopes north of the farm buildings are contoured with strips.

A tributary of Bowmanville Creek flows across the south of Lot 6. Its waters are quite free of pollution. The banks and bottomland are wooded.

Most of the land is these lots is Bondhead loam. There is a strip of Brighton gravelly sand across the southern part of the lots. This corresponds to the physiography of the region as described in Chapter I. The upper part of this sample block is in the till plain, with the Brighton sand being in the sand plain associated with the old beach line of glacial Lake



Iroquois. This beach line curves up into Lots 4 and 5 and may be identified near the farm buildings on the south part of Lot 4.

# CHAPTER 3

## AGRICULTURAL USE

### 1. Past Development

First settlement of the municipalities in the Authority area took place about 1800. Many of these early settlers were United Empire Loyalists who came to the region from St. Lawrence River communities. Early settlement was along the lakefront. In Whitby Township, by 1821, it was still confined largely to the lowest three concessions.

After settlers had cleared sufficient land to build homes, and grow some crops for their immediate needs, they turned to some crop that could be sold or bartered. Wheat became an important crop by 1835, and particularly in the 1840's. During this period wheat-growing led to the clearing of considerable areas of marginal land.

Upper Canada established its early agricultural reputation as a producer of wheat. By the 1880's wheat was the major crop in the counties along the lakeshore west of the Bay of Quinte.

Fall wheat was most grown as it was favoured by settlers. However, fall wheat only did well in a strip of 12 to 15 miles in width along the north shore of Lake Ontario; spring wheat was grown where fall was unsuccessful. Wheat could be sold anywhere in good times and traded for goods in bad times. The census of 1851 shows that almost 50 per cent of the cultivated land in Ontario and Durham Counties was used for wheat. One writer, quoted in History of Agriculture in Ontario*, said that "there is probably no country where there is so much wheat grown in proportion to the population and the area under cultivation, as in that part of Canada west of Kingston".

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* Jones, R.L. History of Agriculture in Ontario, 1613-1880. University of Toronto Press, 1946.

Even at that early date in the use of our agricultural lands, some were reported as being "worn out" by the constant wheat-growing. In 1815, the President of the Agricultural Association said "farms on the whole line in the old settled townships from Montreal to Hamilton..... for a space of eight or nine hundred miles, with few exceptions are what is in Canada, termed worn out".*

The capacity of land to produce wheat was regarded as a standard of its value. After clearing was completed, summer fallow was the usual preparation for wheat. Fallow, or "fallow and peas" was the rule during the great wheat period from 1850 to 1880. Sometimes, particularly when prices were good, wheat followed wheat, and then trouble came, and people would speak of the exhaustion of soils. Few made any real attempt to practise rotation of crops. Nevertheless, probably the majority were reasonably good farmers within the meaning of "good" farming in the middle of the last century.

Although wheat was the most important crop grown in the counties along the Lake Ontario shore, other crops too were part of most farm operations. Barley became important, particularly in the 1860's as a result of the American Civil War which created a demand for beer. This market was greatly reduced by 1880, and was practically ended by the "McKinley Tariff" of 1890.

During the 1850's fruit-growing, particularly apples, became an important sideline, especially on some farms along the lake. Prior to 1850, livestock were not important on most farms, and except for horses, were of poor stock and not well cared for. As farming became more diversified, livestock received more attention.

The "lumberman's market" had an effect in encouraging diversification in farming. In the period 1840 to

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* Squair, John - "The Townships of Darlington and Clarke". University of Toronto Press, 1957.

1875, the lumbering industry was important along the moraine, and further north in the area of the Shield. This created a demand for pork, potatoes, hay and oats, particularly during 1850 and 1860 after better road communications to northern areas had become established.

The American Civil War created a market for wood and pork. The 1860's saw growing overseas markets for butter and cheese too.

Several other factors caused a trend away from wheat. There were some poor crop years and low prices. Railway expansion westwards opened up other wheat growing areas and markets for other farm products were gradually expanding.

In the 1880's better farmers were using rotations including peas or root crops preceding wheat, with less summer fallowing. The passing of extensive wheat-growing, and the use of buckwheat and other cover crops to smother weeds, together with rising land prices led to the end of the summer fallowing practice.

Too many farmers, however, were apparently indifferent to land improvement, as witness a criticism of the Provincial Commissioner of Agriculture in 1880 that "to a large extent, land in Ontario is being indifferently farmed and even gradually exhausted, (and) that the aids of science for its recuperation are being sparingly invited."

There was an interesting tradition in Durham County that growing "two crops of barley" in succession destroyed the fertility of many farms on the uplands and caused their abandonment.

Nevertheless, the use of more livestock and hence manure for fields; the development of new agricultural machinery, and the introduction of new crops and new varieties produced many changes in agriculture as the 19th Century ended and the 20th began.

LAND USE, CROP AND LIVESTOCK PRODUCTION FIGURES*
FOR DARLINGTON, E. WHITBY AND WHITBY TOWNSHIPS

| | 1941 | 1951 | 1956 |
|---|---|---|---|
| No. of farms | 1,350 | 1,150 | 1,060 |
| Size of Farms up | | | |
| to 125 acres | 1,000 | 810 | 760 |
| 125/250 | 285 | 265 | 220 |
| 250+ | 65 | 75 | 80 |
| Area farmland | 130,000 | 119,000 | 114,000 |
| Crops (all) | 73,000 | 58 000 | 53,000 |
| Pasture improved | 20,000 | 23,000 | 23,000 |
| Pasture unimproved | 33,000 | 32,000 | 29,000 |
| Hay | 22,000 | 21,000 | 20,000 |
| Cattle | 26,000 | 28,000 | 32,000 |
| Hogs | 16,700 | 17,500 | 15,000 |
| Sheep | 9,200 | 8,200 | 7,900 |
| Poultry (hens) | 168,000 | 48,000 | 64,000 |
| (Other-mostly turkeys) | 5,600 | 134,000 | 197,000 |

* based on Census of Canada figures

2. Present Use

Agriculture in the townships of the Central Lake Ontario Authority depends largely on animal products; milk, meat and poultry. There is some orchard and truck gardening in the concessions nearest the lake. The westerly portion of Durham County's tobacco area extends into the Bowmanville Creek Watershed.

Primarily the area is a producer for the Toronto market. Dairying is the most important industry, followed by beef, with the latter decreasing as the demand for milk products increases. Hogs are an important source of income on many farms and combine well with beef cattle.

Poultry has ceased to be a sideline on general farms and has become a specialized type of farming with large investments in buildings and equipment, often on a small acreage of land. Of significance is the increase in the numbers of turkeys which are raised on a few large turkey farms in the area.

The conservation survey of the area included an inventory of the present use of the land in the Bowmanville

There are several farms growing tobacco in the Bowmanville area. This is a tobacco field in June.

Cash crops are grown on a number of farms in the lower part of the watersheds. This is a field of canning tomatoes.

Among special crops in the Bowmanville area is the growing of nursery stock for commercial sale.

Creek Watershed. In June 1959 the following crops were being grown:

| | Acres | % of Watershed |
|---|---|---|
| Sod crops - hay - 5693) pasture - 9276) | 14,969 | 50 |
| Grain crops, including corn | 5,610 | 18 |
| Market crops - vegetables and fruit - 800, tobacco - 180 | 1,105 | 3 |
| Idle and fallow | 1,360 | 4 |
| Forest including scrub, plantations and woodlots | 7,583 | 25 |

3. Population Growth and Land Use

The population growth shows moderate increases for all municipalities except Oshawa, which has increased sharply. Population estimates for the next twenty years indicate continued growth at a fairly rapid rate for area municipalities.

The Central Lake Ontario municipalities are at the easterly end of a region sometimes described as the "Golden Horseshoe", which extends through Toronto and Hamilton to the Niagara frontier. This entire area is undergoing rapid change from rural to urban with Toronto and Hamilton as the axis.

There have been several annexations of township land to urban municipalities to take care of the growth. This trend will continue by the increasing size of urban municipalities and by more rural non-farm residents.

In 1959, many farms in Concessions B.F., 1,2 and 3 of each township have changed hands from their original owners. Some of these are now idle, awaiting subdivision, or have been subdivided. Others are held by speculators. Some farms in these concessions are producing short-term crops such as corn or vegetables.

Increasing population in the next two decades may see present population of the area doubled. While most of this will be concentrated in the urban areas, there will be a considerable increase in all municipalities. This population increase may affect land use in the following ways:

(a) need for additional land for housing and industry in urban centres,

(b) demand for rural land for non-farm uses and housing,

(c) larger amounts of rural land adjacent to urban development left idle,

(d) increasing opportunities for non-farm employment by farmers who may continue to operate their farms on a part-time basis.

The lower portion of the watersheds will become urban or semi-urban. This change will probably be most rapid around Whitby and Oshawa.

If the situation prevailing around other centres of rapid growth is any criterion, a considerable amount of land will be left idle while awaiting subdivision. Much land becomes "sterilized", or left idle because of a patchwork pattern of urban subdivision, which could be overcome by orderly growth. The regulation of this growth is primarily the task of municipal councils and planning boards.

The problems of carrying on profitable farming operations close to urban areas tend to cause some farmers to seek other employment. The opportunities, too, for non-farm employment are also greater.

Competition for the use of the land will become greater, and probably increase the land's value. Nevertheless, agriculture will continue to be the major land use, but successful farmers will have to operate at a high rate of efficiency. They will have to make the best possible use of their land's resources.

## 4. Soil Management Problems

There are many factors contributing to the problems of soil management. Some are physical; many are

Recent erosion in a field of spring grain. Such erosion should not go unchecked.

Eroded banks of a gully in Darlington Township.

economic or social. This report is concerned with the physical problems of managing soil. In Ontario the main problems of soil management are those of erosion, drainage and fertility. On one farm or any one piece of land, one problem may predominate. Usually, however, it is a combination of all three.

(a) Erosion

Soil erosion has been an agricultural problem ever since man began to till the soil. In some parts of the world erosion has destroyed the agricultural value of great areas of land. Fortunately, in Ontario, most of our soils are not subject to such serious erosion as are, for example, parts of the United States.

Soil erosion can be defined as "the movement of soil particles from one place to another by wind and water". Under natural conditions the landscape is covered with vegetation which retards run-off and slows down erosion. When land is cleared for cultivation or used for grazing, the problem of erosion may arise. The natural protective cover of vegetation is removed or reduced; cultivation may be carried on up and down the slope and surface water is allowed to run off more freely. Cultivation may change the structure of the soil and reduce organic matter. Such changes may easily produce, in a short time, a less productive soil.

Of the several factors and practices contributing to soil erosion in any given piece of land, the most important is the physical character of the land itself. The texture of the soil, and the length and degree of slope largely influence the amount of erosion that will take place. On top of this, of course, are the cultural practices used by the particular landowner, and the amount and the time of rainfall.

(1) Types of Erosion

Erosion can be caused by either wind or water. In Ontario, erosion by wind is not generally a serious problem

except on a few areas of light sandy soil, or on muck soils that have become excessively dry. In the soils of the Central Lake Ontario watersheds, erosion by water can be damaging. It can be more harmful in some soils than in others.

Water erosion can be divided into three types, although there is no fine line of division.

Sheet erosion is the slow persistent wearing away of soil which may go on for years unnoticed. It is the least spectacular form of erosion, being often hard to see; hence it is often the most dangerous form. A whole field may be affected so that the topsoil with its store of available nutrients may be removed without the owner being aware of the problem until a patch of lighter coloured subsoil appears on his fields. There is evidence of considerable sheet erosion on extensive areas in the northern part of these watersheds, particularly that of Bowmanville Creek.

Rill erosion is caused by water digging out small channels a few inches deep as it runs off sloping land. Rill erosion may develop into gully erosion if allowed to proceed unchecked.

Gully erosion occurs when water run-off is concentrated into channels which are unprotected. This is the most spectacular form of erosion in Ontario. A gully can cause serious damage to a farm or field. Some gully erosion occurs in the upper parts of these watersheds. In most cases they have worked back from stream valleys.

(2) Factors Affecting Erosion

Rainfall - The character and pattern of rainfall over a watershed has a definite influence on erosion. Intense rainfall causes a larger immediate surface run-off than does a slow drizzle. It is these intense rains, usually lasting but a short time that cause the greatest amount of erosion. Heavy spring rains, when the surface is soft but the subsoil still frozen, are often particularly damaging.

Overgrazing of poor pasture, and well worn cattle paths can be the starting point for erosion on hilly land.

Sheet erosion is common on some parts of the moraine.

Sets of abandoned buildings in the moraine are evidence that these soils cannot support profitable agriculture or small farms.

Basically, the effect of rainfall on soil is the effect of the splash of the individual raindrop itself. A falling raindrop has tremendous power, and acts as a major erosion factor. When it hits bare soil it moves particles of earth. This action is multiplied billions of times in a heavy rainfall. Protective plant cover interrupts the falling raindrops, robbing them of their energy, and eases them to the ground with little damage.

Slope - the slope of the land, both in length and steepness, has a particular effect on the run-off of water and consequent erosion. The steeper the slope, the more rapid the run-off of water, and the greater its ability to erode the soil.

Slope steepness is measured in per cent. A 5-per cent slope means that that slope has a fall of 5 feet per 100 feet of length.

Use of the Land - when heavy rain falls on a thick sod, or on the leaves of forest trees or on the litter of the forest floor, the force of the rainfall is broken by the vegetative cover. There is little or no surface run-off and erosion is slight.

Rainfall on clean cultivated fields or on bare spots stirs up the unprotected soil, and there may be a great deal of run-off with consequent erosion. The cultivation practices followed by a landowner have a great effect on the amount of run-off. Good sod cover on a field will absorb rain rapidly and little is lost as surface run-off. A grain crop will give only partial protection to the soil. Row crops are little better than uncovered soil.

Cultivation up and down the slope, soil left bare over winter, and the use of row crops on sloping fields all have a bearing on the amount of water run-off and erosion that will occur on a given piece of land.

(3) Effects of Soil Erosion

Loss of topsoil - The loss of soil by any type of erosion means the loss of that portion of the soil resources of

a farm that contains humus and crop nutrients, the most important layer of the soil. With the loss of this layer potential crop yields are reduced and so are the landowner's profits. It is much more difficult to grow good crops on subsoil and it is usually much less profitable. The physical effects of soil loss upon crop yields vary, of course, with the soil type and kind of crop grown.

Effects of erosion on a soil, such as gullying or exposure of the subsoil, make cultivation more difficult, or in extreme cases, impossible.

Loss of Water - Water loss from a field or farm is not a result of soil erosion, but rather a cause of it. Nevertheless, water loss through excess run-off may be as damaging as soil loss. Cultivation practices that decrease the possibility of soil erosion also decrease excess water run-off. This is particularly important during the summer months when moisture lack may be a limiting factor in crop yields. The more rainfall that can be absorbed into the soil in dry seasons, the greater amount will be available for plant growth.

Pollution - Much of the soil washed off the land eventually finds its way into stream courses and rivers. Many otherwise clear streams are polluted by soil wash. Such pollution, while not a health hazard, does affect fishing conditions in the streams; in some streams it can be the main limiting factor. Silt blankets the streambed and destroys many organisms that live there and provide food for the fish.

Although there is an extensive acreage in these watersheds on which some degree of erosion occurs, so far the silting effect on the streams has not been too great. Most of the streams in the region provide good trout fishing and the banks, at least in the upper reaches, are fairly well protected by vegetation. A soil conservation program for these watersheds will aid in maintaining the present reasonably clear conditions of the streams.

Silting of Reservoirs and Harbours - One of the problems in the development and maintenance of reservoirs to impound water is the loss of storage capacity caused by silting. The main cause of silting is soil waste and sediment from erosion.

There are many old mill dams which have had to be abandoned because their water storage area became filled with silt. In the event that reservoirs should be built on any streams in these watersheds for water control or recreation, silting could be a serious problem.

Not all erosion occurs in the upstream part of the watershed. Nor are farmers to blame for all erosion. In fact much of the silt in some streams comes from erosion following road building operations or construction of subdivisions. This will become a more serious source of downstream silting as urban expansion continues in this area.

Still another bad effect of erosion is the silting of harbours. Each year millions of dollars must be spent in dredging harbours of silt, most of which comes into them through the streams. Harbour facilities in Oshawa and Whitby require extensive dredging to remove silt. Oshawa's harbour is reported to be filled with silt to nearly one-half its depth from Oshawa Creek. This will require removal before the harbour facilities can be developed for Seaway traffic use.

(b) Drainage

Conservation of the soil is good management of the soil. Of the many problems of managing the soils of a farm, one of the biggest is the disposal of excess water. This excess water may be on the land surface, or within the soil itself. Water problems in land management include disposal of excess surface water, and removal of excess moisture in the soil.

(1) Surface Drainage

To remove safely excess water from the surface of the soil special measures may be required. These may

include grass waterways, diversion ditches and protective measures along streambanks.

There are many places throughout these watersheds where grass waterways and other surface water disposal systems are needed. These include not only ditches and small gullies on farm land, but also roadside ditches along township and county roads.

(2) Internal Drainage

Land drainage is essential to good soil management. Excess internal soil moisture is often removed by tile drainage. Tile draining of wet soils can be a major contribution to soil conservation. Some of the most productive land in Ontario is only productive because it is drained. Drainage allows increased yields of crops on low wet areas and permits slopes, where serious erosion is likely to occur, to be planted to more appropriate crops. The controlled removal of excess water from fields can be an aid in combatting soil erosion.

Poorly drained soils, when tile drained, permit increased yields of crops of better quality. The growing season can be longer by reason of earlier planting. With drainage, more flexible, better crop rotations and management practices can be followed.

Drainage may be by means of a tile system or open ditches. A considerable acreage of land in these watersheds has been drained by tile systems. There are still many farms on which tile drainage would improve crop yields and make cultivation much easier.

(c) Fertility

Soil fertility is the ability of any soil to supply the nutrients necessary for plant growth. Maintenance of soil fertility is one of the major management problems of Ontario soils.

Soils vary greatly in their fertility levels. Some of this difference is inherent in the soil itself; much

of it is related to past management practices such as crop rotations, fertilization, cultural practices and susceptibility to erosion. Soil fertility, it should be noted, is not the same as soil productivity, for an otherwise fertile soil may be limited by drainage or other factors lessening production.

The problems concerned with maintenance of adequate soil fertility levels may be those of building up organic matter, liming of acid soil, or the making of proper soil tests.

Organic matter levels may be maintained or increased by use of green manure crops, such as clovers, or by barnyard manure or by working crop residues into the soil. Plenty of humus in the soil not only aids in improving soil structures, but aids in the better use of commercial fertilizer.

Soil testing is used to determine the available supply of major plant nutrients in soil. Results of a soil test are one guide to the farmer in deciding the fertility needs of his soil. Soil tests must be accompanied by observation of crop conditions.

Soil sampling equipment, boxes, tubes and instructions may be obtained from the Agricultural Representative's office. Department of Agriculture publication "Help Yourself to a Soil Test" (Circular 181) gives complete instructions on taking soil samples. It should be consulted, as the method and time of taking soil samples is important in getting best results from them.

# CHAPTER 4

## CONSERVATION MEASURES

Conservation of natural resources does not mean hoarding them. It means using them in such a way that the greatest immediate production or benefits will be derived from them without depleting the basic resources themselves. A sound soil conservation program results in increased production from the resources, and at the same time aids in their improvement.

Soil conservation means using each acre of land for the purpose to which it is best suited. At the same time it must be treated in accordance with its needs for protection and improvement. At one time, soil conservation meant only repairing the damages of soil erosion. It now has come to mean all aspects of good land management. It means protecting the land against all forms of soil depletion, rebuilding eroded soil, conserving moisture for crop use, proper farm drainage and irrigation where needed, building soil fertility and increasing crop yields and farm income.

A few farmers may use soil conservation practices on their land because they believe they should conserve the soil for future generations. Most, however, are interested in land management from the economic standpoint. Conservation measures must increase a farmer's income either immediately or over a period of years. In many cases, farmers want definite figures on how proposed land use changes will affect their incomes. They will only take measures to improve their soil if there is economic incentive for them to do so.

In Ontario, in too few cases are we able to supply specific information on income to be derived from changes in soil management. Figures on income changes resulting from application of various soil-conserving measures

would be of most interest to farmers if based on a farming operation right in their own county or watershed. Possibly Conservation Authorities could take a lead in working out a plan with the Department of Agriculture, through the County Agricultural Representatives and the Economics Branch to obtain more information on the economic benefits of approved conservation practices.

Conservation farming is the use of some or all the practices of good soil management. These practices will vary widely from farm to farm and watershed to watershed. On Class I or II land it may be a matter of improving fertility or of tile drainage. On Class IV land it will probably include improved pastures or grass waterways. Differences in practices will be related to differences in soil, slope, drainage and use.

Conservation measures may be cultural or mechanical. Cultural methods include such practices as crop rotations, improved pastures and cover crops. Mechanical measures include farm drainage, grass waterways, farm ponds and contours and strip crops.

1. Farm Planning

An understanding of the soil problems on any farm will best determine the practices that are required to use the land in the most efficient way. The best way to meet these soil problems is with a farm plan. A farm plan is two things (1) an inventory of the soils and land classes on that particular farm and, (2) a plan of operation for the management of the soil resources of that farm, drawn up to fit that particular farm and farmer's needs. A balanced land use plan for a farm will increase farm income and crop yields. A farm plan represents a sound soil and water conservation program, for it will include recommendations for practices to overcome that particular farm's soil problems.

Farm planning is a service provided by the Soil Advisory Service of the Soils Department, Ontario Agricultural College, and the Ontario Department of Agriculture. Soils specialists are assigned to counties. These men are prepared to draw up farm plans, and to give advice on all problems of soil management. Applications for their services, for which there is no charge, should be made to the Agricultural Representative's office in each county.

A farm plan contains an inventory of the physical conditions of the soil, including topography, erosion and drainage. Based on this information, which is mapped on an aerial photograph of that particular farm, a land use capability map is drawn up for that farm. This divides the land into classes as outlined in Chapter 2. The recommendations of the plan correlate the physical conditions and limitations of that particular farm with the type of operation the farm operator wishes to carry out. A farm plan is the end result of combining the knowledge, experience and wishes of the farmer, with the skill and knowledge of the soils specialist.

There are 14 farms (June 1959) operating under farm plans in the watershed area of this Authority. It is recommended that the Authority's land use advisory board investigate giving more publicity to the operations of these farms and co-operate with the county Agricultural Representative in having other local farmers visit these planned farms.

A farm plan will include some of the conservation measures described in the following sections.

## 2. Erosion Control on Cultivated Land

A major objective of soil management is to protect soil from erosion and hold as much as possible of the rainfall in a place where plants can use it. To grow

crops, soil must be cultivated; baring soil by cultivation leaves it open to the risk of erosion. Soil management will aim to reduce this erosion to the least amount.

One of the goals of soil management and conservation farming is to keep soil losses as close as possible to the rate of loss in a natural landscape. It is usually impossible and impractical to use a farming system that will completely control soil losses. A farmer and conservationist must be aware, however, of the rate of soil loss and depletion by his particular practices, and be ready to change or adjust them if it seems necessary.

A cover of vegetation is the first defence against erosion. Therefore a soil management program will include an increasing quantity and quality of vegetative cover as the land use capability class falls from Class I towards Class VIII. This may be in the form of permanent sod cover for pasture, grassland strips alternated with cultivated land in strip-cropping or merely sod-covered channels for safe run-off of excess water.

(a) Grassland

Grassland is pasture or hayland. For years pasture was regarded as a second-rate crop by many farmers. Fields on their farms not suited to cultivation were left for pasture. Usually no measures to improve them were taken. Today, many farmers are finding that an abundance of forage is the very foundation of profitable livestock farming. This is particularly true in an area such as the Central Lake Ontario region, where dairy farming is a primary agricultural industry.

The production and management of first-class pasture is not a simple job. It is often as difficult to produce good pasture as to produce a grain or cash crop. A peculiarity of grassland is that it is a combination of grasses and legumes, each one with its own peculiarities, as far as soil and fertility requirements are concerned.

Grassland, particularly in a dairy farming area such as this, should never be considered a secondary crop, but rather one that will pay maximum dividends. Grassland farming is a system in which the grasslands are an integral part of the crop rotation scheme; in which some areas, unsuited to cultivation, are put into permanent grass cover; a system in which other areas have a place in crop rotations with a sufficient proportion of grass to protect the soil and improve the production of cultivated crops.

Grassland is of prime importance in controlling erosion and improving soil organic matter and soil moisture relations. Grasses and legumes provide organic matter for the soil, and give it maximum protection against erosion. By improving soil structure and providing a protection against the impact of the raindrop, water is dispersed and more easily able to enter the ground to the benefit of the crop and of the ground-water supplies.

Extensive use of grassland in the soil management of farms in the Central Lake Ontario watersheds can have several benefits. First, it will benefit the individual landowner who is engaged in dairying or beef raising, because it will be one of his most important crops. It will benefit the landowner, and the public generally by aiding in controlling erosion on those soils such as Bondhead, Dundonald and Pontypool (described in Chapter 2) that are particularly susceptible to it. Erosion is already a problem in some areas in the upper reaches, particularly of the Bowmanville Watershed. Such problem areas should be put under a well-managed sod cover or reforested.

Advice on seed mixtures for permanent pastures, renovating old ones, or for controlling erosion can be obtained from the County Agricultural Representative or other personnel of the Department of Agriculture or from a local seedsman.

(b) Grass-Waterways and Gully Control

Grass or sod waterways are water courses on sloping land. They may be natural or they may be man-made. Whatever their origin they are kept in permanent sod. Grass waterways are the most important single item in the control of water run-off from cultivated land for they are a means of conducting excess water safely from fields without allowing erosion to occur. They are a simple and effective erosion control measure that can be used by any farmer.

The best locations for waterways are usually the natural drainage ways of the landscape. In many cases these have always been left in sod, and should continue to be so. The simplest grass waterway is made by tripping cultivating implements as they cross a natural depression. In other instances waterways must be laid out and constructed in order to carry run-off safely.

When constructing a new waterway, it should be large enough to carry safely the heaviest rainfall anticipated in, say, a period of 10 years. A waterway should be broad and shallow; it should have a dense sod cover established on it as soon as possible. This sod cover should be maintained by regular fertilizing and, of course, it should never be broken by cultivation.

Gullies are a symptom of land misuse, usually caused by cultivating too steep land or over-grazing it. Gullies often start in the banks of natural watercourses that have been cut to a considerable depth.

When still small, gullies can be shaped into grass waterways to prevent any further erosion. More serious gullying will require more extensive, and usually expensive, treatment. This may involve mechanical measures such as small check dams, the planting of vegetation or trees to control erosion or the construction of diversion waterways to redirect the run-off water over another path, while the gully is being repaired.

There are many places where grassed waterways should be used on farms in these watersheds. The rolling topography and the often light soils will erode quite easily when subject to concentrated water run-off on cultivated fields. On most farms in the area, grassed waterways can be easily and quite inexpensively constructed with the farmer's own equipment. In many municipalities, the township road maintainer can be obtained for a reasonable rental and used to shape the watercourse.

There are a number of gullies, particularly in the north-east part of the Authority region. A number of these have developed, not on recently cultivated land, but on pasture land that has been over-grazed. Some of these gullies can be repaired as grass-waterways; others will require more extensive work if they are to be eliminated. Some of the slopes and small valleys where these gullies occur should be reforested.

(c) Contouring and Strip-Cropping

Strip-cropping is a system of growing crops in strips or bands laid out in a systematic manner as a barrier to erosion. The arrangement of crops in strips should be such that erosion-resistant crops, such as grasses, are alternated with clean cultivated crops which may be subject to erosion.

Contouring is the arrangement of the strips across the slope at right angles to the natural slope of the land. The best slopes for contouring are broad and smooth. Contour tillage is most effective on slopes of 2 per cent to 8 per cent, and not more than 300 feet long. Here the practice reduces soil losses to less than half that of up- and down-hill cultivation. Satisfactory operation of strip-cropping may require the removal or relocation of fencelines. Most farms in this part of Ontario are laid out on a rectangular survey grid, hence

fields are often not according to the "lay of the land", but fenced up and down the slope.

The main benefit of contouring and strip-cropping, is the reduction of soil and water losses. Another important benefit, however, is the greater ease and economy of farm operations. If strips are fairly long, there is less frequent turning, and power requirements are often reduced by "level" operation across the slope rather than up and down. One study showed savings of 13 per cent in time and 10 per cent in fuel when contour cultivation with power implements was substituted for up and down operation.

Contour cultivation, when used in combination with other good farming practices, effectively aids in conserving moisture. Small ridges and terraces formed by cross-slope cultivation act as small dams to retain water, and provide greater opportunity for its infiltration. In addition, the alternating sod strips slow down the water run-off and allow greater infiltration.

Sod strips alternated with cultivated land act as a barrier to water run-off from the cultivated strips. In some areas, particularly in tobacco-growing districts, sod strips are used as a barrier to wind erosion.

There are several farms in the area now using contouring and strip-cropping as a part of their soil management operations. This method of cultivation was recommended in their farm plan as a means of combatting the erosion problem on their sloping fields.

Advice and assistance on erosion control on cultivated land can be obtained through the Agricultural Representative from the Soils Specialist of the Ontario Agriculture College. He will be prepared to give assistance on laying out contours and strip-crops, grass-waterways or the repairing of gullies.

(d) Woodland

Well-managed woodland plays an important part in any soil and water conservation program. It can help protect the individual landowner from soil and water losses. Forestry is important in the overall picture of resource management on a watershed basis.

Forestry can be an integral part of many farm management plans. Most farms in these watersheds have some area of woodland on them. Many could have more.

Certain land classes, particularly Class VI and VII, otherwise described as submarginal land, should be under forest cover. If already wooded, they should remain so; if not, reforestation may be needed.

Reforestation is an erosion control measure on steeply sloping fields or about the sides and head of gullies. In the upper part of the watershed there is land which should be kept under permanent vegetation, either grass or trees. Some of this land can best be used as pasture, with areas of forest cover on the steepest slopes.

Woodland around springs, or the source area of streams will often aid in the regulating or restoring of flow. A farm plan may recommend that certain areas of woodland be set aside for wildlife cover.

(e) Farm Drainage

Soil drainage is essential to good soil management. The successful use of many acres of good farmland in Ontario is possible only because of artificial drainage.

Some of the benefits of soil drainage are (1) increased yield and improved quality of crops; (2) earlier planting is possible and hence a longer growing season; (3) drainage may make low, wet areas available for grain or intertilled crops. Slopes, where the erosion hazard is higher, can be put in grass. (4) It permits the use of

more regular crop rotations; (5) the controlled removal of excess water from soils can be an aid in combatting soil erosion.

Excess water can be removed by means of open ditches or by tile underdrains. In the area of this Authority, there is little need for open ditch drains; most drainage will be by means of tile.

Whatever the area to be drained, it is well to have a survey made before starting. A survey plan will show the proper location of mains and laterals, location of outlets, grades, depths, and number of tile required.

The Department of Agriculture, through its agricultural engineering fieldmen will, upon application, carry out a survey for drainage work. Applications and information may be had from the Agricultural Representative's office.

Bulletin 501, "Farm Drainage" of the Ontario Dept. of Agriculture gives information on all types of drainage situations.

(f) Farm Ponds

An adequate water supply is essential on any farm for livestock and household uses. In many areas the need for water supplies is increasing. This increase is due to much greater demands for water on many farms; demands caused by increased numbers of livestock, piped water supply in house and barn, water for spraying, and irrigation. On many farms, wells are not able to supply constantly this increased need for more water.

Farm ponds can be an excellent source of water. They may be used as emergency or regular supply of livestock water. If near buildings, they are a source of water supply for irrigation or spraying. In addition they have conservation value for recreation and fish and wildlife.

A pond may get its water from surface run-off, springs or a permanently flowing stream. When designing a pond the water source and the use should be kept in mind. To be successful, a pond must be properly located, and properly constructed.

The Central Lake Ontario Authority may wish to follow the practice of most other Authorities and provide financial assistance towards the construction of farm ponds. Any financial assistance given should be accompanied by regulations requiring proper construction and maintenance. The Authority should, however, consider farm pond assistance already being given by the County of Ontario, and be certain that any Authority program does not duplicate one already available.

In any case, the Authority may consider extending technical assistance on farm pond construction. This could supplement such service already available from the Agricultural Engineering Extension Specialist of the Department of Agriculture.

The Authority, regardless of what direct assistance it may give, should publicize the necessity of adequate and proper construction of ponds and dams. It should be emphasized that care must be taken in the building of dams, that spillway capacity should be adequate and emergency spillways always provided. Many small dams have failed, because these precautions have not been taken. It should be noted, that the permission of the Surveyor General for the Province is required before any structure may be placed across a permanent stream.

# CHAPTER 5

## AN AUTHORITY PROGRAM

Preceding chapters have described the area of the Central Lake Ontario Authority, its physiography and its soils. A section has dealt with soil management problems, and the present conditions in two of the watersheds. A chapter deals with conservation measures, all of which have application at some place or under some conditions in the area.

The Central Lake Ontario watersheds are predominately rural, but with extensive urban development in their lower portions. Urbanization will continue, likely at an increased rate. This will make all conservation problems even more important, as with increasing population will come increasing demands on all natural resources of the land.

The Central Lake Ontario Authority is one of the smaller ones in area in the Province and it has a high proportion of agricultural land. This land is mainly used for livestock production and crops to support them. The area's location and population growth may change this in future.

### 1. What Other Authorities Are Doing

This section summarizes land use and reforestation programs of other Conservation Authorities and is presented as a review of the possibilities, rather than as a recommendation for all parts of other Authorities' programs.

#### (a) Farm Ponds

Fifteen Authorities have a farm pond program by which they encourage the construction of ponds for conservation purposes on privately-owned land. Most Authorities give financial assistance in the form of a subsidy. This assistance varies from a straight $50 per pond to a sliding scale of subsidies based on pond size with a maximum of $300 for a pond of over 3 acres.

All of these Authorities have regulations concerning the construction of ponds which include minimum sizes, depths, number per farm, fencing, etc.

Most Authorities provide technical advice and assistance on pond construction which is sometimes given by the field officer or Authority staff. One Authority retains the services of a professional engineer to do pond surveys.

(b) Tree Planting

Nineteen Authorities have an active forestry program. Many of these Authorities supply tree planters; several supply tractors and men to operate them. There is usually a charge for this service, often one-half the actual cost.

Details of forestry assistance programs are described in the Forestry Report.

(c) Grass Waterways

Several Authorities are promoting the installation of grass waterways on private land by offering financial assistance towards their construction. This subsidy varies in amount, but may go as high as $150 per farm.

(d) Land Use Demonstrations

A number of Authorities have promoted demonstrations. These have taken several forms. In some instances they have been demonstrations of specific land use practices, e.g., grass waterways or gully-control projects. These have been carried out on private land and with some measure of financial assistance from the Authority.

The Saugeen Authority has purchased, and operates, a demonstration pasture farm. The Metropolitan Toronto and Region Conservation Authority has a land use and pasture demonstration on a part of its Albion Hills Conservation Area. The Grand Valley Authority has established a number of co-operative projects with landowners to demonstrate the value of farm planning. This Authority also owns a demonstration farm, and carries out certain land use demonstrations on part of its Pinehurst Conservation Area.

Some of these demonstration projects are carried on co-operatively with the Department of Agriculture and the Ontario Agricultural College, and with local farm organizations.

2. What This Authority Might Do

The Authority can hope to carry out by itself only a very small proportion of the conservation work on the watershed. This is particularly true in soil conservation programs.

Soil conservation and management is essentially the responsibility of the landowner. Theirs is the decision involving various methods of using their soil resources. Usually these decisions will be made in light of their past experience, and of expected economic returns.

It is the responsibility of public bodies to provide landowners with some of the information necessary to make their decisions on soil management and conservation. Technical advice is available from the Ontario Department of Agriculture, and the Ontario Agricultural College.

The Authority should have an aggressive program to interest landowners in the watershed in the government services available to them; services which, if used, can greatly aid them in improving their farm operations and income, and at the same time conserve soil and water.

(a) Publicity

The Authority should publicize the services available to farmers from the several government departments. They should publicize the benefits of soil conserving measures. Such publicity can take the form of publications, newspaper and radio, and field tours. The last method can be particularly effective.

The Authority, through its field officer or other staff, may be in a position to give technical assistance on certain soil conservation practices. Authority staff, or members, when visiting a landowner for any purpose, should take the opportunity of telling him about assistance available in soil conservation.

They should try and interest the landowner in applying soil conservation practices, if needed, on his land.

(b) Co-operation With Other Organizations

Conservation Authorities are in a unique position to promote and to carry out conservation programs. However, they can only be successful in achieving their objectives if they have public co-operation. To get results, Conservation Authorities need the interest and co-operation of agricultural organizations.

Such organizations as the County Soil and Crop Improvement Associations, Federation of Agriculture and Farmers' Unions, the Women's Institutes, County 4-H Clubs and the various livestock breed associations are established and respected. They are all vitally interested in farm problems. The Conservation Authority, being a new agency, should seek the co-operation of these organizations in contacting farmers and promoting its objectives. The Authority and these organizations can work to mutual advantage.

(c) Land-Judging Competitions

The Central Lake Ontario Authority has already assisted in sponsoring a land-judging competition. It is recommended that they continue to encourage this worth-while activity. Such events aid farmer operators and farm youth in better appreciating the qualities, as well as the limitations of their soil.

(d) Farm Ponds

Farm ponds have value to the landowner and for conservation. Most Authorities assist in their construction with advice and grants. However, financial assistance is already available through the two counties in this area. It is therefore not recommended that any additional financial assistance be given.

Technical advice and assistance are the most important part of a farm pond program. To be successful, a farm pond must be well located, and well constructed. Many ponds have failed through insufficient attention to these factors.

Authority staff may assist the Department of Agriculture in the survey of farm ponds and in their inspection for adherence to regulations governing construction.

(e) Tile Drainage

The benefits of tile drainage in soil management have been pointed out elsewhere.

Certain financial assistance is available in the form of loans under the Tile Drainage Act. This permits landowners to borrow up to $3,000 per 100 acres or fraction for 10 years at an interest rate of 4 per cent.

The Metropolitan Toronto and Region Conservation Authority has a tile drainage assistance program whereby a subsidy of $20 per thousand tile is paid. The Central Lake Ontario Authority should consider the advisability of similar assistance.

(f) Grassed Waterways

There are many farms on the watersheds where grass waterways could well and profitably be constructed. The Authority should publicize the advantages of grass waterways and promote their construction. They should also consider the advisability of giving some financial assistance toward their construction.

(g) Demonstrations

In several Authorities grass waterway demonstrations have brought considerable interest. The Authority might co-operate with the landowner in constructing a waterway. They could supply machinery, and perhaps seed, in return for permission to use the project as a demonstration.

In addition to waterways other approved land practices could be carried out as demonstrations on private land. Such practices might include farm ponds, reforestation, laying out strips and contours, fenceline removal, etc.

Where such demonstration projects are established, the Authority should take care to provide only limited financial assistance. This can sometimes best be done through providing

machinery. The main responsibility for initiating the measures used as a demonstration, and for their maintenance afterwards, should be the landowner's. Only when this is the case will such demonstrations be meaningful to other farmers who must carry out the measures entirely on their own.

Care should be taken in any demonstrations to carry out only such projects as any farmer can do himself with his own, or readily available, equipment. Strict control of costs should be maintained, as well as complete figures. Part of the demonstration agreement should be that the landowner keep an account of all costs involved, as well as any figures available on economic benefits.